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Drone Home

By Lev Grossman

A few months ago I borrowed a drone from a company called Parrot. Officially the drone is called an AR.Drone 2.0, but for simplicity's sake, we're just going to call it the Parrot. The Parrot went on sale last May and retails for about $300.

It's a quadcopter, meaning it's a miniature helicopter with four rotors; basically it looks like a giant four-leaf clover designed by Darth Vader. It's noisy and a bit fussy: it spits error messages at you from a comprehensive menu of them, and it recovers from catastrophes slowly and sulkily. (Pro tip: quadcopters mix poorly with greenery.) But when it's on its best behavior, the Parrot is a little marvel. You control it with an app on your smart phone, to which it feeds real-time video in return. Mashing the Take Off button causes it to leap up to waist height and hover there, stock still, in the manner of Harry Potter's broomstick. It's so firmly autostabilized that on a hot day small children will gather under it to get the cool downwash from its rotors.

It's a toy, the robotic equivalent of a house pet. But just as cats and dogs are related to tigers and wolves, the Parrot is recognizably genetically related to some very efficient killers.

Flying a drone, even just a Parrot, makes you realize what a radically new and deeply strange technology drones are. A drone isn't just a tool; when you use it you see and act through it — you inhabit it. It expands the reach of your body and senses in much the same way that the Internet expands your mind. The Net extends our virtual presence; drones extend our physical presence. They are, along with smart phones and 3-D printing, one of a handful of genuinely transformative technologies to emerge in the past 10 years.

(PHOTOS: Everyday Drones: Photographs by Gregg Segal)

They've certainly transformed the U.S. military: of late the American government has gotten very good at extending its physical presence for the purpose of killing people. Ten years ago the Pentagon had about 50 drones in its fleet; currently it has some 7,500. More than a third of the aircraft in the Air Force's fleet

are now unmanned. The U.S. military reported carrying out 447 drone attacks in Afghanistan in the first 11 months of 2012, up from 294 in all of 2011. Since President Obama took office, the U.S. has executed more than 300 covert drone attacks in Pakistan, a country with which we're not at war. Already this year there are credible reports of five covert attacks in Pakistan and as many as eight in Yemen, including one on Jan. 21, the day of Obama's second Inauguration. The Pentagon is planning to establish a drone base in northwestern Africa.

The military logic couldn't be clearer. Unlike, say, cruise missiles, which have to be laboriously targeted and prepped and launched over a period of hours, drones are a persistent presence over the battlefield, gathering their own intelligence and then providing an instantaneous response. They represent a revolution in the idea of what combat is: with drones the U.S. can exert force not only instantly but undeterred by the risk of incurring American casualties or massive logistical bills, and without the terrestrial baggage of geography; the only relevant geography is that of the global communications grid. In the words of Peter Singer, a senior fellow at the Brookings Institution and the author of Wired for War: The Robotics Revolution and Conflict in the 21st Century, drones change "everything from tactics to doctrine to overall strategy to how leaders, the media and the public all conceptualize and decide upon this thing we call war."

Having transformed war, drones are getting ready to transform peace. A year ago Obama ordered the Federal Aviation Administration (FAA) to expedite the process of integrating "unmanned aerial vehicles," as drones are primly referred to within the trade, into civilian airspace. Police departments will use them to study crime scenes. Farmers will use them to watch their fields. Builders will use them to survey construction sites. Hollywood will use them to make movies. Hobbyists will use them just because they feel like it. Drones are an enormously powerful, disruptive technology that rewrites rules wherever it goes. Now the drones are coming home to roost.

They've been on their way for some time. If you define a drone as any remote-controlled device that can spy or fight from a distance, they go back over 100 years.

(A word about that word drone: there's a lot of ambivalence about it in the industry because of its negative associations with targeted killing. I've been corrected, and even upbraided, by drone users and manufacturers, military and civilian, for failing to use terms like unmanned aerial vehicle or unmanned aircraft system (UAS) or remotely piloted vehicle. While literally accurate, those terms have a clumsy, euphemistic feel. Hence drones.)

Nikola Tesla patented a wirelessly remote-controlled powerboat in 1898. The U.S. built unmanned, gyroscopically stabilized biplanes during WW I, though it never put one in the field. During WW II a company called Radioplane manufactured drones for target practice; Marilyn Monroe worked there until she was spotted on the job by an alert Army photographer.

In 1944 the Navy's Project Anvil tried to adapt B-24 Liberators to take off from the U.K. under human control, crammed with bombs, then continue on to Germany after the pilot parachuted to safety. The program was an utter failure, and it claimed the life of Joseph Kennedy, older brother of the future President, when his B-24 blew up prematurely. The U.S. used drones in Vietnam for reconnaissance, but the Drone Age didn't truly dawn until 2001, on the first night of the ground war in Afghanistan, when the first Predator strike took place. That specific Predator, designated No. 3034, now hangs from the ceiling of the National Air and Space Museum in Washington.

Strictly by the numbers, America's drone campaign has been an overwhelming success. According to the New America Foundation, a nonprofit public-policy institute based in Washington, U.S. drone attacks have claimed the lives of more than 50 high-value al-Qaeda and Taliban leaders. But the seductive theoretical simplicity of drone warfare — omniscient surveillance, surgical precision, zero risk — has led the nation into a labyrinth of confusion and moral compromise. In 2012 Obama described the government's drone campaign as "a targeted, focused effort at people who are on a list of active terrorists trying to go in and harm Americans" that hasn't caused "a huge number of civilian casualties." Whether this is accurate may depend on what the word huge means to you. It's hard to get good statistics: the government's drone strikes in Afghanistan are conducted by the military and are mostly overt, but elsewhere they're carried out either solely or jointly by the CIA and are generally covert, meaning the U.S. doesn't admit that they're happening. There are several nonprofit organizations that aggregate and reconcile reports of covert drone attacks. The Bureau of Investigative Journalism, a U.K. nonprofit, estimates that since 2004, CIA drone attacks have killed 2,629 to 3,461 people in Pakistan alone, of whom 475 to 891 were civilians. The New America Foundation puts those numbers somewhat lower, from 1,953 to 3,279, of whom 261 to 305 were civilians. (The CIA declined to comment for this story.)

The morality of the U.S. drone campaign, and its legality under domestic or international law, is the

subject of bitter debate. Counterterrorism chief John Brennan and other Administration officials argue publicly that the drone strikes are legal under the 2001 authorization that allows the use of force against those responsible for the Sept. 11 attacks and their affiliates. "These platforms ... are an advanced tool that provides in certain cases a clear perspective on what's happening on the battlefield and are what allows us to be precise," a U.S. official told Time. "And that is, of course, the goal of all our operations: to put pressure on al-Qaeda, to take people off the battlefield where that's been deemed necessary and, of course, to avoid any collateral damage wherever possible." But critics, including Jameel Jaffer, director of the ACLU's Center of Democracy, say the government's targets have broadened beyond the scope of the 2001 authorization. The international legal outlook is even murkier: a U.N. special rapporteur has written, "If other states were to claim the broad-based authority that the United States does, to kill people anywhere, anytime, the result would be chaos." According to reports in the New York Times and elsewhere, the Obama Administration conducts so-called signature strikes, which are aimed not at specific high-level targets but at any person or people whose behavior conforms to certain suspicious patterns. On Jan. 24 the U.N. announced a special investigation into civilian deaths resulting from U.S. drone strikes.

The U.S. government's position is that it declines on national-security grounds to declassify the full legal justifications for its covert drone attacks; so far that position has withstood a legal challenge. But whatever their legal validity, the practical effectiveness of drone strikes is undermined by their tendency to outrage and radicalize populations against the U.S. As controversial as it is, there was heartwarming bipartisan agreement in last fall's presidential election that American drone policy wasn't going to be seriously discussed by either candidate. It's possible that the elevation of Brennan to head of the CIA will bring about greater transparency and public accountability. Brennan has pushed for both. Critics of the drone program say his close involvement in the development of the current drone campaign doesn't set a great precedent.

Bottom line: the U.S. seems to be struggling to adapt its 20th century moral code of warfare to the 21st century practice of sending flying robots into other countries to kill people. It appears that drones are evolving faster than Americans' ability to understand how, legally and ethically, to use them.

Five years ago the Parrot couldn't have existed; it's an anthology of fresh-off-the-vine technologies. Five years ago there weren't cameras as tiny and sharp or chips as tiny and fast. Batteries weren't as light and didn't last as long. Smart phones and tablets still had a long way to go, as did the hyperminiaturized sensors with which the Parrot is studded: an accelerometer, a gyroscope, a magnetometer and a pair of ultrasound altimeters. A few weeks ago, Parrot announced an add-on GPS widget that will be available later this year.

In a way, drones represent the much delayed coming of age of a field that has experienced a prolonged adolescence, namely robotics. For decades robots stumbled along on the ground, slowly and clumsily, rarely achieving even bipedal locomotion. Right now the apex of consumer robotics is that humble domestic trilobite, the Roomba. But it turns out that the earth's surface is simply not the robot's natural

domain. When robots take to the air, they're faster and nimbler and more graceful than humans will ever be. All along, robots just wanted to be drones.

If drones like the Parrot are related to Predators on one side, on the other side they're related to toys: plastic radio-controlled planes and helicopters. But their range, power and additional sensors and smarts make drones something much more. They're an extension of the person operating them, vessels for that person's consciousness, capable of disturbing the universe in ways that go far beyond play. It's a visceral feeling with the Parrot; one can only imagine what it's like to fly a Reaper, though a report released by the Pentagon in December 2011 gives us some idea. Even though they work from the safety of air-conditioned bunkers and go home to their families every night, almost 30% of Air Force drone pilots suffered from burnout, and 17% were clinically distressed. They may not have been in danger, but some part of them was nevertheless in combat.

For most other Americans, the experience of drones is limited to celebrity cameos. They're characters in popular culture. Last fall Saturday Night Live ran a sketch about four drones that formed a hot new boy band. A joke YouTube video from 2012 purporting to show a quadrotor pimped out with a machine gun has racked up 16 million views. A squad of nimble, agile quadcopters from the University of Pennsylvania performed a son-et-lumière dance number at the Cannes Film Festival.

Up close, the reality is a bit different. There's something uncanny about drones. Flying one is a heady experience, but being watched by one is an eerie, oppressive, somewhat annoying feeling — wielding the Parrot in public will get you a range of reactions, from "OMG I have to try that" to "Get that giant bug out of my face." They're machines with ghosts in them, and the ghost is saying, "I can see you, but you can't see me." It's roughly analogous to interacting with an anonymous commenter on a blog: you're dealing with someone who is both present and absent, who has decided that what they say or do will have consequences for you but not for them.

Drones bring that asymmetrical dynamic out into the real world: a drone is the physical avatar of the virtual presence of a real person. They provoke a new kind of anxiety, quite unlike the nuclear terror of the 1980s or the conspiracy-theory paranoia of the 1990s. They're a swarming, persistent presence, low-level but ubiquitous and above all anonymous. They could be al-Qaeda or your government or your friends and neighbors.

Businesswise, the Parrot is still a product looking for a market beyond well-heeled dronophiles. Unless you find aerial photography extremely personally gratifying (which, granted, a lot of people do), the Parrot doesn't have a lot of immediate practical applications. Which raises the question: What are drones good for, aside from hunting people? The answer, it turns out, is a lot, and more all the time.

U.S. Customs and Border Protection has been using Predators to monitor the Mexican border since 2005. It currently fields a fleet of 10 and has put in for 14 more. Last fall, NASA used a Global Hawk to study Hurricane Nadine. But flying a drone for purposes other than recreation requires a certificate from

the FAA, and those certificates are hard to come by. The government is working to correct that: last Valentine's Day Obama signed the FAA Modernization and Reform Act, which among other things ordered the FAA to establish six drone-testing ranges, fast-track requests for permission to use drones and figure out a scheme for their integration into U.S. airspace by 2015.

So far the list of applicants for permission to fly drones consists mostly of universities, public agencies and drone manufacturers. According to its FAA application, Washington State's department of transportation wants to try using drones for avalanche control. The U.S. Department of Energy plans to use a helicopter drone to take air samples. The Forest Service wants drones to help fight fires. Police departments in Maryland, Alabama, Texas, Florida, Washington, Arkansas and Utah have all sought permission to fly drones, encouraged by a $4 million Homeland Security program to accelerate the adoption of drones by local law enforcement.

The Mesa County sheriff's office in Colorado was one of the first to use drones in police work. It currently fields a Draganfly X6 and a fixed-wing drone called a Falcon UAV. "If it's a tactical operation, like there's a barricaded subject or something of that nature, we'll use the helicopter," says Ben Miller, director of Mesa County's UAV program. "Also aerial photography. We can fly 50, 60 ft. [15 to 18 m] off the ground and literally photo-map an entire crime scene." The Falcon, which flies faster and longer but can't hover, is used to sweep wide-open spaces for, say, lost hikers. "We do it because of cost," Miller says. "If it wasn't for cost, we'd just go out and buy a [conventional] helicopter."

For now — as with PCs in the 1970s — much of the serious hacking and tire kicking is still going on in university labs and among hobbyists who build, modify and fly their own drones for fun. DIY Drones, a flourishing online community founded by former Wired editor Chris Anderson, has more than 30,000 members.

But the drone industry is ramping up for a big landgrab the moment the regulatory environment starts to relax. At last year's Association for Unmanned Vehicle Systems International (AUVSI) trade show in Las Vegas, more than 500 companies pitched drones for filming crowds and tornados and surveying agricultural fields, power lines, coalfields, construction sites, gas spills and archaeological digs. A Palo Alto, Calif., start-up called Matternet wants to establish a network of drones that will transport small, urgent packages, like those for medicine.

In other countries civilian drone populations are already booming. Aerial video is a major application. A U.K. company called Skypower makes the eight-rotored Cinipro drone, which can carry a cinema-quality movie camera. In Costa Rica they're used to study volcanoes. In Japan drones dust crops and track schools of tuna; emergency workers used one to survey the damage at Fukushima. A nature preserve in Kenya ran a crowdsourced fundraising drive to buy drones to watch over the last few northern white rhinos. Ironically, while the U.S. has been the leader in sending drones overseas, it's lagging behind when it comes to deploying them on its own turf.

One issue slowing the integration of drones into everyday American life is that they crash a lot.

Predators, while they appear fearsome and otherworldly with their blind, bulbous, alien heads, run on relatively poky snowmobile engines, and they're surprisingly fragile. The news is full of expensive drones falling out of the sky. Last June a massive Global Hawk, with a 116-ft. wingspan and a $233 million price tag, crashed in a marsh near Salisbury, Md., during a training flight. In December a Reaper crashed in the Nevada desert. The Washington Post reported on a run of drone crashes at civilian airports overseas, including two in the past year at an airport in the Seychelles, where Reapers were being used to keep an eye out for Somali pirates. Taken together, the Global Hawk, the Predator and the Reaper are the most accident-prone aircraft in the Air Force fleet, according to a Bloomberg report.

You don't get the sense that drones are solid citizens of the airways yet, ready to share lanes with passenger jets. In fact, in September the Government Accountability Office (GAO) issued a report on drones that expressed serious concerns about, among other things, their unreliable performance, their lack of sense-and-avoid technology that would help them keep from colliding with other aircraft and their lousy electronic security. Last year a professor at the University of Texas demonstrated that it was possible to remotely hack into and take over a Homeland Security drone in midflight.

The GAO report also mentioned "privacy concerns over the collection and use of UAS-acquired data." A lot of people share those concerns. Drones are the most powerful surveillance tool ever devised, on- or offline. A Reaper drone equipped with the Air Force's appropriately named Gorgon Stare sensor package, for example, can surveil an area 2½ miles across from 12 angles at once. Its field of view swallows entire cities. The Pentagon's Defense Advanced Research Projects Agency (DARPA) has produced an imaging system called ARGUS that can pick out an object 6 in. long from 20,000 ft. in the air. In a story worthy of the Onion, USA Today reported in December that Air Force officials were so swamped with the 327,384 hours of drone footage taken last year, they consulted with ESPN about how to edit it down to the highlights, à la SportsCenter.

Imagine how Americans would feel if the Gorgon Stared at them. It's not a hypothetical. In June 2011 a county sheriff in North Dakota was trying to track down three men, possibly carrying guns, in connection with some missing cows. He had a lot of ground to cover, so — as one does — he called in a Predator drone from a local Air Force base. It not only spotted the men but could see that they were in fact unarmed. It was the first time a Predator had been involved in the arrest of U.S. citizens.

Exactly how often Predators have been seconded to local law-enforcement agencies in this manner isn't known; that information is the object of a pending Freedom of Information Act request by the Electronic Frontier Foundation. But there's at least one Reaper equipped with Gorgon Stare at large in the U.S. Legislators from both parties, in North Dakota and elsewhere, are scrambling to throw legal restraints around the domestic use of drones. In Virginia, the relevant bill is supported by both the ACLU and the Virginia Federation of Tea Party Patriots.

(In case you're worried that drones lack allies in Congress, rest easy: there's a Congressional Unmanned Systems Caucus with 60 members. With global spending on drones expected to nearly double over the

next decade, to $11.3 billion, industry groups like the AUVSI are rapidly ramping up their lobbying budgets.)

Until actual legislation is passed, it won't be completely clear what information the government can and cannot gather using drones. There are certainly precedents: the Supreme Court has ruled that the police can, under the Fourth Amendment, fly an airplane over your fenced backyard and check out whether you're growing pot back there. It's not a giant leap to imagine them flying a drone instead. But where does it stop? The framers didn't anticipate technology that could hover for days, keeping an eye on exposed backyards and porches, that could work in networked swarms, see through walls with thermal imaging, recognize faces and gaits and track license plates. "If we have a bad guy named Waldo," Singer says, "and we have to find Waldo somewhere in that city, we will naturally gather information about all the people around Waldo, not out of malice but just because that's the way it is. What happens to that information? Who owns it? Who stores it? Who shares it? Big questions."

All the police officers I spoke with were, if anything, extravagantly conscientious in the use, storage and disposal of information their drones had gathered. But the potential for mission creep and outright abuse is great. In September a report by the Congressional Research Service, titled "Drones in Domestic Surveillance Operations," came to the following non-conclusion: "the sheer sophistication of drone technology and the sensors they can carry may remove drones from [the] traditional Fourth Amendment framework." Well, that settles that.

And that's just the government. Drones don't care who they work for. They'll spy for anyone, and as they get cheaper and more powerful and easier to use, access to military-grade surveillance technology will get easier too. Voracious as they are for information, drones could take a serious chunk out of Americans' already dwindling stock of personal privacy. It's certainly not legal to fly a drone up 10 stories to peer through the curtains into somebody's bedroom, but it's just as certain that somebody's going to do it, if

they haven't already. Last February an animal-rights group in South Carolina launched a drone to watch a group of hunters on a pigeon shoot on private property. The hunters promptly shot it down. It might be America's first case of human-on-drone violence, but it won't be the last.

Whatever happens on the civilian front, the ongoing dronification of the U.S. military is barreling ahead. The Predator has already been superseded by the larger, faster, more powerful Reaper, which is in turn looking nervously over its shoulder at the even larger, jet-powered Avenger, currently in the testing phase.

The U.S.'s skunkworks are disgorging drones in a bizarre profusion — like Darwin's finches, they're evolving furiously to fill more and more operational niches and creating new ones as they go. Already soldiers carry hand-launchable Raven surveillance drones and kamikaze Switchblade drones for targeting snipers. The K-MAX unmanned helicopter ferries cargo around Afghanistan for the Marines. The Navy's SeaFox, a single-use underwater drone, is hunting for Iranian mines in the Persian Gulf. The Army is testing a Long Endurance Multi-Intelligence Vehicle, essentially a 300-ft.-long unmanned blimp designed to squat over a battlefield at high altitude for weeks at a time. (Its manufacturer, Northrop Grumman, promises "more than 21 days of unblinking stare.") DARPA has fielded a tiny drone that mimics the flight of a hummingbird, and it's mulling a network of deepwater drones that would dwell on the seafloor but — like Godzilla — rise to the surface in times of need.

Drones are learning to think for themselves. Those University of Pennsylvania drones are already semiautonomous: you can toss a hoop in the air and they'll plot a trajectory and fly right through it. (Whether or not you count Google's self-driving cars as people-carrying, highway-borne drones seems like a question of semantics.) They're also gaining endurance. In June, Boeing tested a liquid-hydrogen-powered drone called the Phantom Eye that's designed to cruise at 65,000 ft. for four days at a time. Boeing's Solar Eagle, which has a 400-ft. wingspan, is scheduled for testing in 2014. Its flights will last for five years.

This technology will inevitably flow from the military sphere into the civilian, and it's very hard to say what the consequences will be, except that they'll be unexpected. Drones will carry pizzas across towns and drugs across borders. They'll spot criminals on the run and naked celebrities in their homes. They'll get cheaper to buy and easier to use. What will the country look like when anybody with $50 and an iPhone can run a surveillance drone? Last fall the law schools at Stanford and NYU issued a report, "Life Under Drones," which was based on 130 interviews with Pakistanis. It makes for unsettling reading. "Drones are always on my mind," said a man from Islamabad. "It makes it difficult to sleep. They are like a mosquito. Even when you don't see them, you can hear them. You know they are there."

Right now the U.S. is the only nation that operates drones on a large scale, but that will change: flying drones is hard, but it's not that hard. Singer estimates that there are 76 other countries either developing drones or shopping for them; both Hizballah and Hamas have flown drones already. In November, a Massachusetts man was sentenced to 17 years for plotting to attack the Pentagon and the Capitol with

remote-controlled planes. (The drone equivalent of the Newtown, Conn., atrocity is simply beyond contemplation.) The moral ambiguity of covert drone strikes will clarify itself very quickly if another country claims the right under international law to strike its enemies in the U.S. There may come a day when the U.S. bitterly regrets the precedents it has set.

Americans are great and heedless adopters of new technologies, and few technologies are as seductive, promise so much at so little political and financial and human cost, as drones. They give us tremendous new powers, and they seem to ask very little of us in return. Obama captured the singular quality of drone warfare precisely in a remark that appears in Mark Bowden's recent book The Finish. "There's a remoteness to it," he said, "that makes it tempting to think that somehow we can, without any mess on our hands, solve vexing security problems." That illusion is just what makes drones such a challenge, especially as we introduce them into our own country. Drones don't just give us power, they tempt us to use it.